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A Quality Assurance Project Plan for Monitoring Gaseous and Particulate Matter Emissions from Broiler Housing (Appendix U)

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Appendix U: Monitoring Equipment Specifics

1. INNOVA 1412 Photoacoustic Field Gas-Monitor

Product Data

1412 Photoacoustic Field Gas-Monitor

USES:

- Indoor Air Quality measurements
- Ventilation measurements using tracer-gas
- Occupational Health and Safety measurements – of possible production or accumulation of toxic/carcinogenic substances in working areas
- Monitoring of anaesthetic agents in hospitals
- Emission monitoring of greenhouse gases from agricultural production
- Emission monitoring of exhaust from chemical processes

FEATURES:

- Selectively measures a wide range of gases/vapours
- Linear response over a wide dynamic range
- High stability (low drift) makes calibration only necessary 1-2 times a year
- Extremely reliable due to self-testing procedures
- User-friendly procedures for calibrating the monitor, presenting and analysing measurement data via the PC user-interface
- Accurate – compensates for temperature and pressure fluctuations, water-vapour interference and interference from other known gases
- Extremely low-volume flushing possible
- Operates immediately – no warm-up time necessary
- Presents measurement data via connected PC both in tabular and graphic formats – up to 5 gas concentration and water vapour graphs displayed, simultaneously

Introduction

The 1412 Photoacoustic Field Gas-Monitor is a highly accurate, reliable and stable quantitative gas monitoring system. It uses a measurement system based on the photoacoustic infra-red detection method, and is capable of measuring almost any gas that absorbs infra-red light.

Gas selectivity is achieved through the use of optical filters. By installing up to 5 of these filters in the 1412, it can measure the concentration of up to 5 component gases and water vapour in any air sample. Although the detection limit is gas-dependent, it is typically in the ppb region. The accuracy of these measurements is ensured by the 1412's ability to compensate for temperature and pressure fluctuations, water-vapour interference and interference from other gases known to be present. Reliability of measurement results can be ensured by regular self-tests, which the 1412 performs. By the nature of this measurement system, it requires no consumables and very little regular maintenance, for example for most applications recalibration is only necessary 1-2 times a year.

The monitoring system is easily operated through either of the two user interfaces: the front panel with its push-buttons and display providing short explanatory texts, or the PC Software, with its graphical interface. Both interfaces enable the monitor to be set-up, a measurement sequence started and the resulting concentration values of the specified gases viewed while monitoring.

The monitor is equipped with 2 standard interfaces: IEEE-488 and RS-232. These enable the monitor to be integrated into automated process systems. The 1412 has a built-in pump system that allows samples to be drawn from up to 50 m away.

Selectivity

The gas selectivity of the 1412 is determined by the optical filters installed in its filter wheel.

Because water is nearly always present in ambient air and absorbs infra-red light at most wavelengths, it contributes to the total acoustic signal in the analysis cell. Therefore, the monitor is permanently

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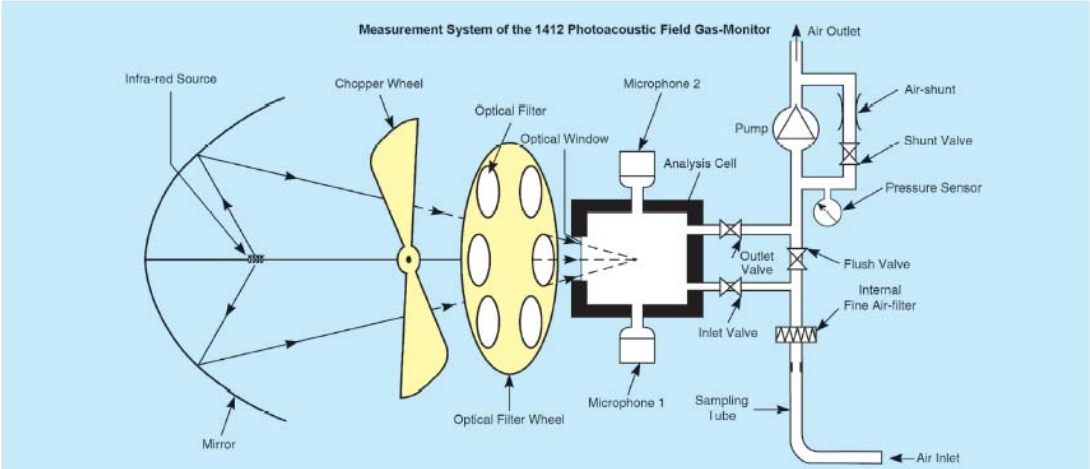

Measurement Cycle

1. The pump draws air from the sampling point through the air-filter to flush out the "old" air in the measurement system and replace it with a "new" air sample. The pressure sensor is used to check that the pump sequence is elapsed successfully and to measure the actual air-pressure.
2. The "new" air sample is hermetically sealed in the analysis cell by closing the inlet and outlet valves.
3. Light from an infra-red light source is reflected off a mirror, passed through a mechanical chopper, which pulsates it, and then through one of the optical filters in the filter wheel.
4. The gas being monitored, causing the temperature of the gas to increase selectively absorbs the light transmitted by the optical filter. Because the light pulsating, the gas temperature increases and decreases, causing an equivalent increase and decrease in the pressure of the gas (an acoustic signal) in the closed cell.
5. Two microphones mounted in the cell wall measure this acoustic signal, which is directly proportional to the concentration of the monitored gas present in the cell.
6. The filter wheel turns so that light is transmitted through the next optical filter, and the new signal is measured. The number of times this is repeated is dependent upon the number of gases being measured.
7. The response time is down to approx. 13 sec. for one gas or water vapour, or approx. 40 sec. if 5 gases and water vapour are measured.

fitted with a special filter, which measures water vapour and enables the 1412 to compensate for watervapour's interference. By selecting different filters, this technique can also be used to cross-compensate for known interferent gases.

Calibration

After the relevant optical filters are installed, the monitor must be calibrated. This is achieved through easy-to-use menudriven instructions. With its high stability, calibration of the 1412, is seldom necessary more than once a year.

Calibration is performed using either the PC Software or directly from the front panel.

Operation

The 1412 monitoring system is easy to operate using either the PC Software or the frontpanel push-keys (which can be locked and accessed at 3 levels using passwords). The monitor can be operated as both an on-line and off-line instrument. Using these user-interfaces with their logical division of information, everything that needs to be defined is achieved prior to starting the monitoring task.

Setting-up the Monitor

The Set-up option enables all the parameters necessary to complete the monitoring task to be defined.

Within this option, the Sample Integration Times (S.I.T.) is set - enabling measurement results to be weighted - sensitivity against speed.

Starting Measurements

Once the set-up parameters have been defined, measurements can be started either immediately or later using a delayed start time. Once started, the monitoring task then continues until it is stopped either manually or using a defined stop time.

Alarms

When measuring, two Alarm trigger levels, which provide high alarm limit 1 and 2 for each measured gas, can be defined. These can also be linked to audible alarms.

Measurement Results

On-line Measurements

Using one or more of the monitor's standard interfaces, measurement results are transferred directly to a PC or control console. Here they can be displayed on screen as real-time values in tables and graphs (see Fig. 1) or integrated into the process system.

In the PC Software, the graphs can be set up to display only the desired gases, defined concentration ranges and results from statistical analysis.

Also, when using the PC Software, all measurement data is stored in user-defined databases, in a MS-Access format.

Off-line Measurements

Gas-measurement result data is displayed on the 1412's screen (Display Memory) as soon as it is available, and is constantly updated. During a task, the 1412 performs running statistical analysis of the measured gas concentrations, calculating a variety of values for each monitored gas.

The data in Display Memory can be copied to the Background Memory, which is a non-volatile storage area. Data stored in Background Memory can be recalled to Display Memory. From this memory, data can, if necessary, be uploaded to the PC Software and printed out in a list form on any standard text printer via the 1412's IEEE and RS-232 interfaces.

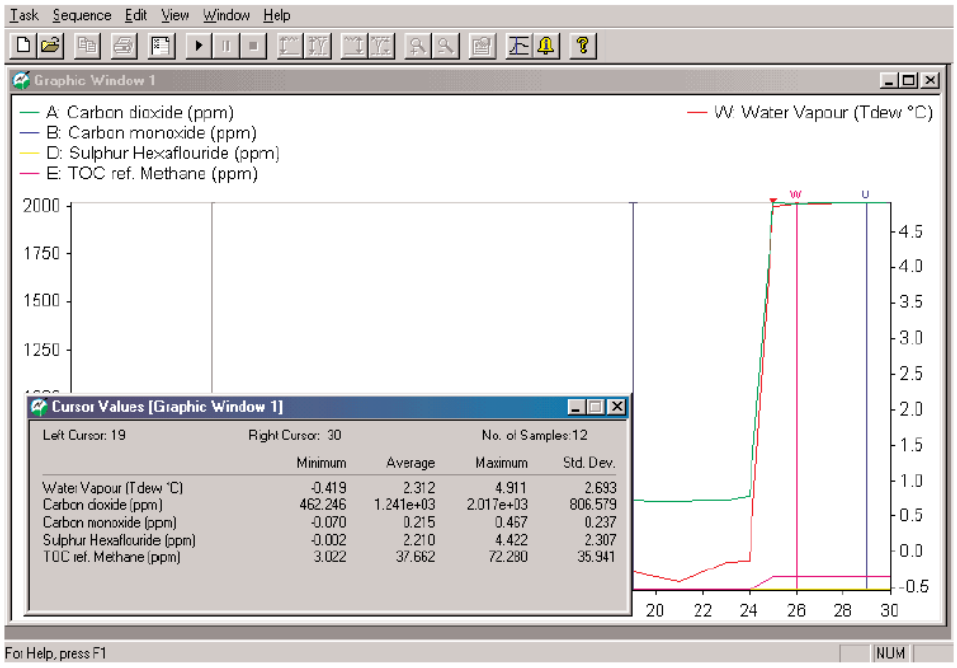

Fig.1 Displaying detailed measurement data using the cursors in the graphic or table windows

Reliability

Executive selftest check: software, data integrity, and the 1412's components, to ensure that they function properly. If a fault is found, it is reported in the measurement results, so that the integrity of the results can be ensured.

If the power-supply fails, the 1412 will automatically start-up again when power is restored. Measurement data stored in the monitor's memory is not affected.

Maintenance

The only maintenance tasks necessary are calibration and changing the air-filter. Both tasks are easily performed, and the frequency for changing the air-filter depends on the individual applications.

Remote Control Options

Innova AirTech Instruments offers two additional application software programs, the 7300 Application Software and the 7620 Application Software.

Using 7300, a computer can remotely control a 1412 together with one 1309 Multipoint Sampler for sequentially monitoring air-samples from up to 12 locations.

Using the 7620, a computer can control a 1412 together with up to two 1303 Multipoint Sampler and Doser units. This enables up to 12 locations to be dosed with a tracer-gas and air-samples to be drawn from each location for analysis by the 1412. The software uses the resultant measurements to calculate the air-change or ventilation efficiency of each location.

Ordering Information

1412 Photoacoustic Field Gas-Monitor

Optical filters necessary for the user's monitoring task can be ordered together with the 1412, and installed by *INNOVA*. The 1412 is then delivered zero-point and humidity interference calibrated.

Includes following accessories

AT 2177	PTFE tubing
Mains cable	
WL 0945	RS-232 Interface cable (9pin–25pin) null-modem included

PC Software for Photoacoustic Field Gas-Monitor
Instruction Manual (CD Rom)

Optional Accessories

The 1412 can be span-calibrated for certain gases (option UA 1098) — contact your local *INNOVA* representative for details of the gases for which this can be done.

QA 0164	Tweezers

27 optical filters:

UA 0968 – UA 0989 and	
UA 0936	Optical Filters
UA 6008	Optical Filter
UA 6009	Optical Filter
UA 6010	Optical Filter
UA 6016	Optical Filter
UA 1098	Span Calibration
UD 5037	Nafion (copolymer of TFE & fluorosuphonyl monomer) tubing
AO 0265	IEEE–IEEE Interface cable
AO 0264	IEEE–IEC 625 Interface cable
WL 0946	RS-232 Interface cable (25pin–25pin) null-modem included
JP 0600	6-pin DIN plug (male) with locking collar for alarm relay
AF 0614	PTFE tubing
UA 1357A	Genie Membrane separator
1303	Multipoint Sampler and Doser
1309	Multipoint Sampler
7300	Application Software
7620	Application Software
BA 6011	Instruction Manual (Printed)

Innova AirTech Instruments A/S reserves the right to change specifications and accessories without notice

Specifications 1412

MEASUREMENT TECHNIQUE:
Photoacoustic infra-red spectroscopy.

Your local *INNOVA* representative will assist in the selection of suitable optical filters. Details are provided in the Gas Detection Limits chart.

RESPONSE TIME:
Is dependent on the Sample Integration Time (S.I.T.) and the flushing time defined. The fastest response time for one gas is 13s and for 5 gases and water vapour 40s. Please see the examples below:

MEASUREMENT SPECIFICATIONS:•

Monitor Set-up	Response Times
S.I.T.: "Normal" (5s) Flushing: Auto, (Tube 1m)	One gas: ~25s 5 gases + water: ~75s
S.I.T.: "Fast" (1s) Flushing: Tube "OFF" Chamber 4s	One gas: ~15s 5 gases + water: ~45s

Detection Limit: Gas-dependent, but typically in the ppb region. Using the Gas Detection Limits chart, the detection limit for a selected sample integration time (S.I.T.) can be calculated.
Dynamic Range: Typically 4 orders of magnitude (i.e. 10.000 times the detection limit at 5 S.I.T.). Using two span concentrations it can be expanded to 5 orders of magnitude.
Zero Drift: Typically ± Detection limit♣ per 3 months•.
Influence of temperature♦: ±10% of detection limit♣/°C.
Influence of pressure♥: ±0.5% of detection limit♣/mbar.
Repeatability: 1% of measured value•
Range Drift: ± 2.5% of measured value per 3 months•.
Influence of temperature♦: ± 0.3% of measured value/°C.
Influence of pressure♥: – 0.01% of measured value/mbar.
Reference conditions:
- Measured at 20°C, 1013 mbar, and relative humidity (RH): 60%. (A concentration of 100x detection limit♣ was used in determining these specifications.)
- ♦ Measured at 1013 mbar, and RH: 60%.
- ♥ Measured at 20°C and RH: 60%.
- ♣ Detection limit is @5s S.I.T.

Interference:
The 1412 automatically compensates for temperature and pressure fluctuations in its analysis cell, and can compensate for water vapour in the air sample. If an optical filter is installed to measure a known interferent the 1412 can cross-compensate for the interferent.
Acoustic Sensitivity: not influenced by external sound.
Vibration Sensitivity: strong vibrations at 20Hz can affect the detection limit.

INTERNAL DATA STORAGE CAPACITY:
Dependent on the number of gases being measured. Sufficient for a 12-day monitoring task, monitoring 5 gases and water vapour every 10min.

GENERAL:
Pumping Rate: 30cm^3/s (flushing sampling tube) and 5cm^3/s (flushing measurement chamber).
Power Requirement: 100 - 240VAC, 50 – 60Hz. Complies with IEC536 Class 1 Safety Standards.
Power Consumption: ~120VA.

Air Volume per sample:

Flushing Settings	Volume of Air
Auto: Tube Length: 1m	140cm^3/sample
Fixed Time: Chamber 2s, Tube 3s	100cm^3/sample
Fixed Time: Chamber 2s, Tube "OFF"	10cm^3/sample

Alarm Relay Socket: for connection to one or two alarm relays (visual/audio). Alarm levels for each gas are user-defined. Max. 25VDC, max. 100mA.
Back-up Battery: 3V lithium battery, life-time 5 years. This protects data stored in memory, and powers the internal clock.

Dimensions:
Height: 175 mm (6.9 in).
Width: 395 mm (15.6 in).
Depth: 300 mm (11.8 in).
Weight: 9 kg (19.8lbs).

COMMUNICATION:
The monitor has 2 interfaces: IEEE 488 and RS-232. These are used for data exchange and remote control of the 1412. The PC Software communicates using the RS-232 interface.

PC SOFTWARE REQUIREMENTS:
Hardware:
A Pentium (166MHz) processor or better.
Min. 64MB of RAM (depending on Op Sys.).
Min. 40MB of space available on the hard disk.
One RS-232 port.
Software:
Windows 98, 2000 (min. SP1),
NT 4.0 (min. SP4).

WARNING!
The 1412 must not be placed in areas with flammable gases/vapours in explosive concentrations, or be used to monitor explosive concentrations of these. Also, monitoring of certain aggressive gases, or a very high concentration of water vapour, could damage the 1412. Ask your local INNOVA representative for further information.

COMPLIANCE WITH STANDARDS:

CE	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. UL-mark indicates compliance with: UL Standards.
Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. UL 3101–1: Safety requirements for electrical equipment for laboratory use. CAN/CSA–C22.2 No. 1010.1–92: Safety requirements for equipment for measurement, control and laboratory use.
EMC	EN 50270:1999. Emission and immunity requirements for electrical apparatus for the detection and measurement of combustible gases, toxic gases, or oxygen. Emission for type 1 and immunity for type 2. EN 50081–1:1992. Generic emission standard. Part 1: Residential, commercial and light industry. EN 61000/–4-2: Immunity requirements for electrostatic discharge. EN 61000/–4-3: Immunity requirements for radiated electromagnetic field. ENV 50204/–4-4,4-5,4-6,4-8,4-11: Immunity requirements for radiated electromagnetic field. FCC Class B limits.
Temperature	IEC68–2-1 & IEC68–2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: + 5°C to + 40°C (+41°F to +104°F). Storage Temperature: –25°C to +55°C (–13°F to +131°F).
Humidity	IEC 68–2-3: 90% RH (non-condensing at 30°C).

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2. Optical Filters for INNOVA 1412

The optical filters

INNOVA optical filters display different characteristics while sharing a basic design. Each filter comprises three separate infra-red elements; a narrow-band pass element, a short-wave pass element and a wide-band pass element. The narrow-band pass element has very specific transmission characteristics. These are further defined by the short-wave pass and wide-band pass elements, which prevent transmission of light at other wavelengths; as a result *INNOVA* optical filters have low leakage characteristics.

The narrow-band pass filter determines the centre wavelength and bandwidth of the optical filter, and thus which gases can be detected. The range of optical filters span the entire "fingerprint" region (700 to 1350 cm^{-1}) plus the region between 2000 and 3000 cm^{-1}. See Fig. 1 and Table 3. The "gap" in the infra-red spectrum between 1350 cm^{-1} and 2000 cm^{-1} is due to strong water absorption. This region is only suited for monitoring water vapour.

In Table 3 the specification for the 26 optical filters can be studied. The bandwidth is given as a percentage of the filter centre wavelength. The bandwidth of e.g. UA0987 thus becomes 3.4 µm × 6.0% = 0.204 µm.

Fig. 1 and Table 3 contain 4 special filters:

- SB0527 is the standard filter for measurement of water vapour. The detection limit for this filter is 50 ppm.
- EB6010 is a high sensitive filter for measurement of water vapour. The detection limit for this filter is 0.1 ppm. Main application is measurement of humidity in pure gases.
- EB6009 is a high sensitive filter for measurement of Carbon dioxide. The detection limit for this filter is 4 ppb. Main application is measurement of Carbon dioxide in pure gases.
- EB6008 is a dedicated filter for measurement of mustard gas. The detection limit for this filter is 0.1 ppm.

Choosing a filter

Immunity to interfering species is perhaps the most important consideration in any gas detection programme. Careful cosideration of potential interference is therefore essential. Depending on the concentration and type of interfering gases and on the measurement range required, different filters may be selected in different applications in order to measure the same gas.

Table 3. Filter specifications:

Optical filter Number	Filter Centre		Bandwidth
	mm	cm^{-1}	%
UA0987	3.4	2950	6.0
UA0986	3.6	2800	3.0
EB6009	4.3	2347	2.0
UA0983	4.4	2270	1.3
UA0985	4.5	2215	2.0
UA0984	4.7	2150	3.0
SB0527	5.1	1985	2.0
EB6010	5.9	1700	5.9
UA0968	7.7	1291	5.5
UA0969	8.0	1254	5.5
UA0970	8.2	1217	5.5
EB6008	8.3	1210	3.0
UA0971	8.5	1179	6.0
UA0972	8.8	1139	6.0
UA0973	9.1	1101	6.0
UA0974	9.4	1061	6.5
UA0936	9.8	1020	6.5
UA0975	10.2	981	6.5
UA0976	10.6	941	7.0
UA0988	10.6	946	3.7
UA0977	11.1	900	7.0
UA0978	11.6	861	7.0
UA0979	12.2	822	7.5
UA0980	12.8	783	7.5
UA0981	13.4	746	7.5
UA0982	14.1	710	7.5

Dimensions: Diameter: 31.00 mm Height: 5.15 mm
Operating temperature: -20°C to +70°C
Relative humidity: 0% to 95% RH
Storage temperature: -25°C to +70°C

All *INNOVA* optical filters comply with MIL-SC-48497A requirements.

Converting Concentration Units

The detection limits listed on this wall chart are given in "parts per million" by volume (ppm) at 20°C and 1 atmosphere of pressure. These values can be converted into the concentration unit "mg/m^3" by using equation (1) given in the box below.

For a gas at 20°C and at 1 atmosphere of pressure:

$$\text{Concentration (mg/m}^3\text{)} = \frac{\text{Concentration (ppm)} \times \text{Molec. Weight (g/mol)}}{24.04 \text{ l/mol}} \quad (1)$$

To Convert ppm to mg/m^3 (at 20°C and 1 atm.):

Reading from the chart - the detection limit at 20°C and 1 atmosphere pressure of Toluene is 0.5 ppm using the UA0974. The molecular weight of Toluene is 92.14 g/mol. Using equation (1) shown in the box above, the detection limit can be calculated in mg/m^3:

$$\text{Detection Limit} = \frac{0.5 \times 92.14}{24.04} = 1.92 \text{ mg/m}^3$$

To Convert Measured Gas Concentrations from mg/m^3 to ppm (at T °C and P atm.)

Equation (1) can only be used to convert concentration units of a gas measured at a pressure of 1 atmosphere and at a temperature of 20°C. If the gas is at a pressure of P atmospheres and its temperature is T Kelvin, then the conversion equation becomes:

$$\text{Concentration (ppm)} = \frac{\text{Concentration (mg/m}^3\text{)} \times \text{Molar Volume (l/mol)}}{\text{Molec. Weight (g/mol)}}$$

Where: Molec. Weight = molecular weight of the substance (in g/mol). Can be found in the Detection Limit Chart.

Molar Volume = is the volume occupied by one mole of an ideal gas at a specified temperature and pressure. Table 2 lists the molar volume of a gas at various temperatures and 1 atmosphere of pressure. Its value at a temperature of T K and a pressure of P atmosphere can be calculated from the following equation:

$$\text{Molar Volume} = \frac{RT}{P}$$

Where: T = temperature of the gas in K
R = Gas Constant
= 8.2054×10^{-2} litre atm. K^{-1} mole^{-1}
P = pressure of the gas in atmospheres

Temperature (°C)	-20	-15	-10	-5	0	+5	+10	+15	+20	+25	+30	+35	+40	+45	+50
Molar Volume (l/mol)	20.76	21.17	21.58	21.99	22.40	22.81	23.22	23.63	24.04	24.45	24.86	25.27	25.68	26.07	26.50

Table 2. Molar Volume of an Ideal Gas at 1 Atmosphere of Pressure at Different Temperatures

Calculation of Detection limits for different SIT settings

To calculate the detection limit at Sample Integration Times other than 5 seconds the following equation must be used:

Detection limit = Detection limit in chart × DLF

The factor DLF can be read in Table 1.

Example:

Reading from the chart – the detection limit for Sulphur hexafluoride (SF_6) using the optical filter UA0988 is 0.006 ppm. Calculating the detection limit using SIT (Sample Integration Time) of 0.5 second and 50 seconds gives the following results:

Detection limit SF_6 (SIT of 0.5) = 0.006 ppm × 3.2 = 0.019 ppm
Detection limit SF_6 (SIT of 50) = 0.006 ppm × 0.3 = 0.002 ppm

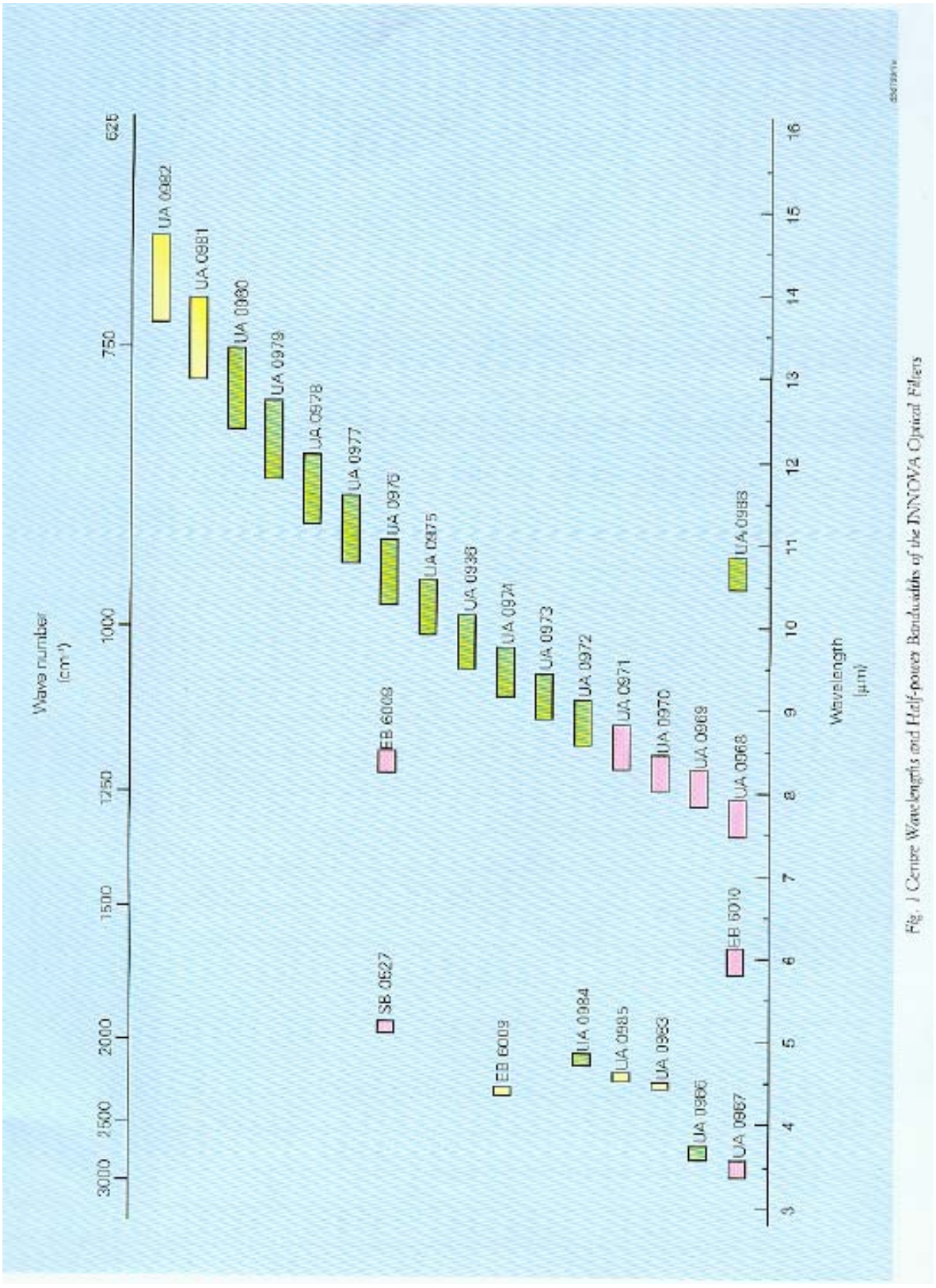


Fig. 1 Center Wavelengths and Half-power Bandwidths of the INNOVA Optical Filters

3. California Analytical Digital to Analog Module for INNOVA

CALIFORNIA ANALYTICAL

INSTRUMENTS INC.

Operating instructions for the Model CAI WB 1318 digital to analog module.

The CAIWB 1318 analog module works in conjunction with the INNOVA Model 1312 or 1302 Photo Acoustic Multi gas Analyzers. Model 1312 has five sample channels and a sixth humidity channel. The data from these six channels are available in the ASCII serial data. The analog module converts the ASCII format into the analog current or voltage. All the channels are individually isolated. The analog outputs are available either as current or as voltage. The current range is 4 to 20 ma and the voltage is 0 to 10 V.

INPUT / OUTPUT

The input to the 1318 is connected at the DB - 9 pin RS-232 connector. The various outputs can be accessed at the DB - 25 pin connector. Details of the pin identification and the corresponding channel are:

Channel number	Filter	Positive	Negative
1	A	14	1
2	B	16	3
3	C	18	5
4	D	20	7
5	E	22	9
6 (H_2O)	W	24	11

This arrangement can also be found by referring to Figure 1.

COMMUNICATION BETWEEN 1312 and CAIWB 1318 ANALOG MODULE

TYPE OF CABLES REQUIRED:

To input the data you must use the null modem cable (CAI –750) provided with the 1312. There will be no communication between the 1312 and the analog module if ordinary passthrough RS 232 cables are used.

COMMUNICATION PARAMETERS:

Baud rate	9600
Stop bits	2
Data bits	8
Parity	NONE
Hard wire mode	Three wire
Hand-shake	X – ON / X – OFF

A PARTIAL RESET must be made on 1312 whenever the communication parameters are changed.

TURN OFF THE POWER TO THE 1312 WHENEVER THE COMMUNICATION CABLES ARE EITHER CONNECTED OR DISCONNECTED.

If the 1312 is used to communicate with the computer change the communication parameters to:

Baud rate	9600
Stop bits	1
Data bits	7
Parity	Even
Hard wire	Switched line
Hand shake	Hard wired

TESTING:

Turn the power on. Push the " F " button . A menu appears. Select the desired channel by pressing the appropriate channel number. The current range is set by pushing 7or 8 or 9 for the 4, 12, 20 ma. The current may be measured with a multi - meter in the ma mode

SETTING UP THE RANGES:

Input data range can be programmed by setting the highest value expected for each of the first five channels. The sixth channel is fixed with a range of – 60° C. To + 60° C. Dew point. – 60 ° C. equals the minimum output. These settings are done at the factory before shipping.

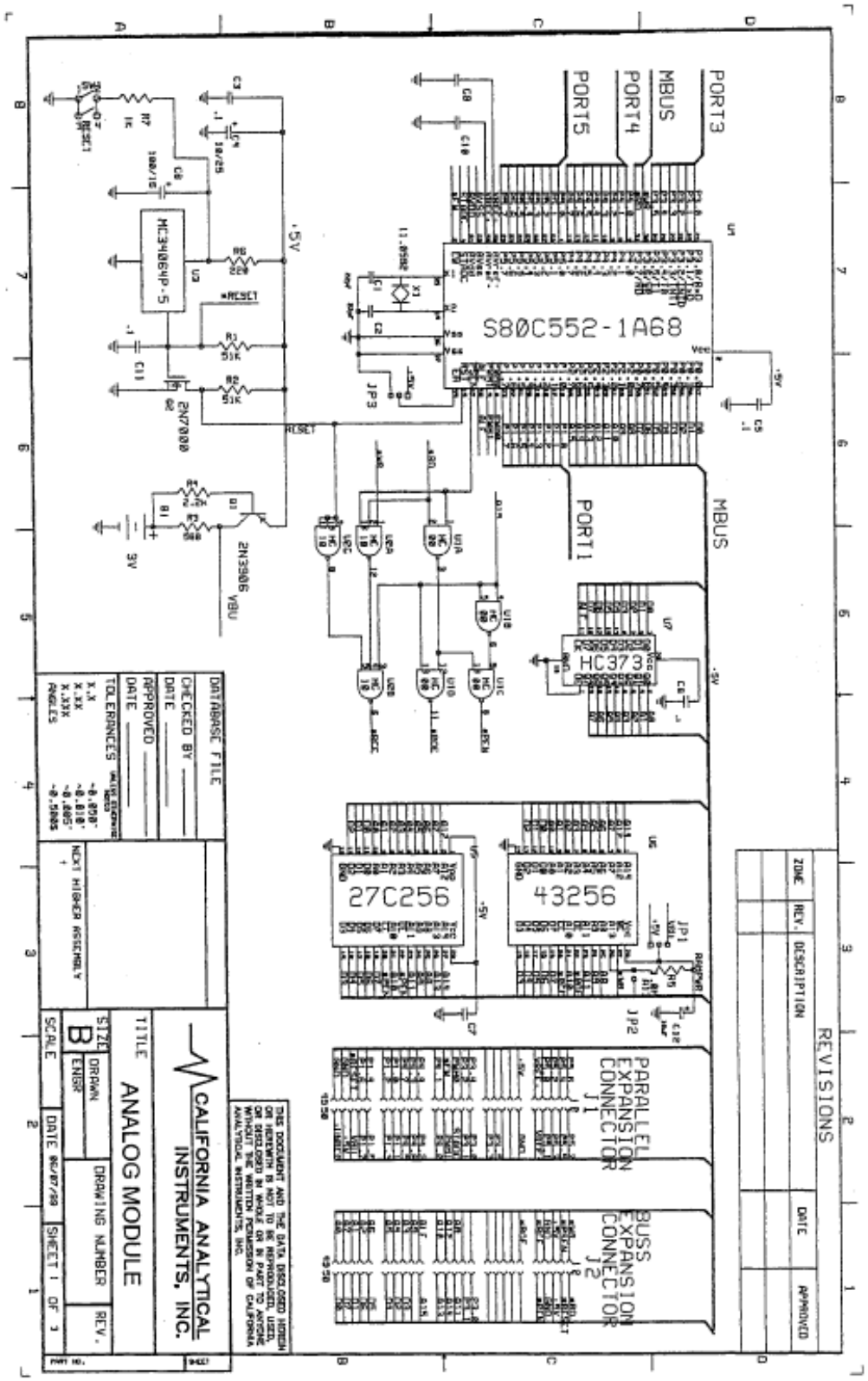
CHANGING THE RANGES:

Turn the power off. Hold the " F " button down for 5 seconds while turning the power back on. When released a secret menu appears displaying the current settings for all the five or requested programmable channels. To change the range, follow the menu on the screen. For example to change the previously set value on channel 1 press 1 on the keypad. Enter the new range by sequentially pressing digits followed by B for plus (+) and A for minus (-) to enter the exponent. If the entry is correct accept it by pressing " F ". If not press C and start over. Press C after making the desired changes for the channels 1 to 5. By way of illustration 100E-03 is 0.100, this corresponds to 20 ma at 0.1 ppm., 12 ma at 50 E-03 or 0.05 ppm and about 4 ma for 1E –02 or smaller.

Pressing any key during the operation, the monitoring will cease and a maintenance menu will appear. The operator can select any or all the five channels and set the output to 4,12 or 20 ma. Exiting the maintenance menu will return the analog module to normal operating mode.

OUTPUTS:

All the outputs are expressed in ma.as set from 4 to 20 ma. If the readout from 1312 is zero or a negative number then the output current will appear as zero. If the humidity is set in degrees dew point Celsius, below zero the output current will appear as zero ma.. However, if the ppm units for moisture are selected then the current output will be ma at temperatures below zero degrees.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27C256
43256
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PORT4
MBUS
PORT5
PORT1
MBUS
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2N3906
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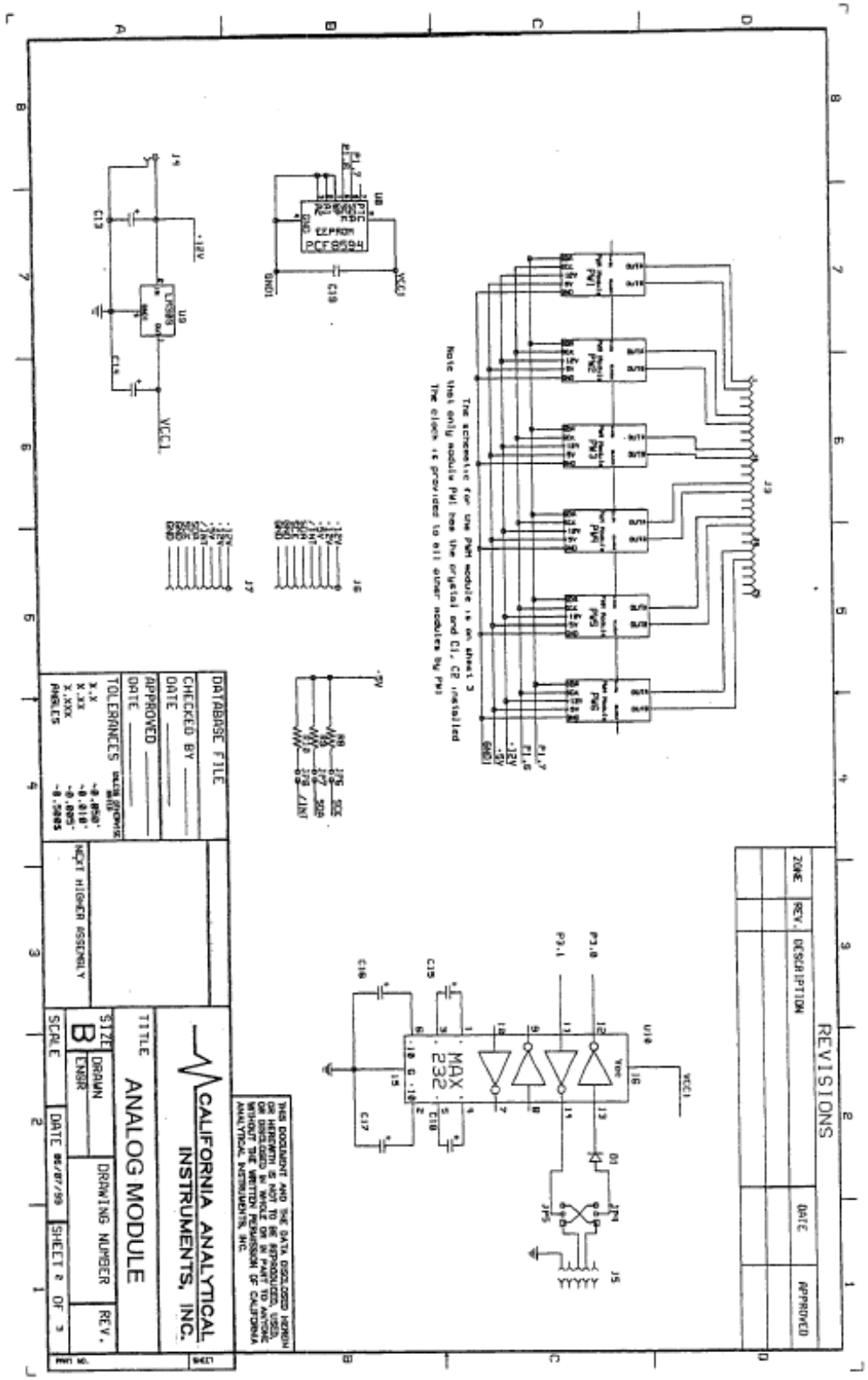
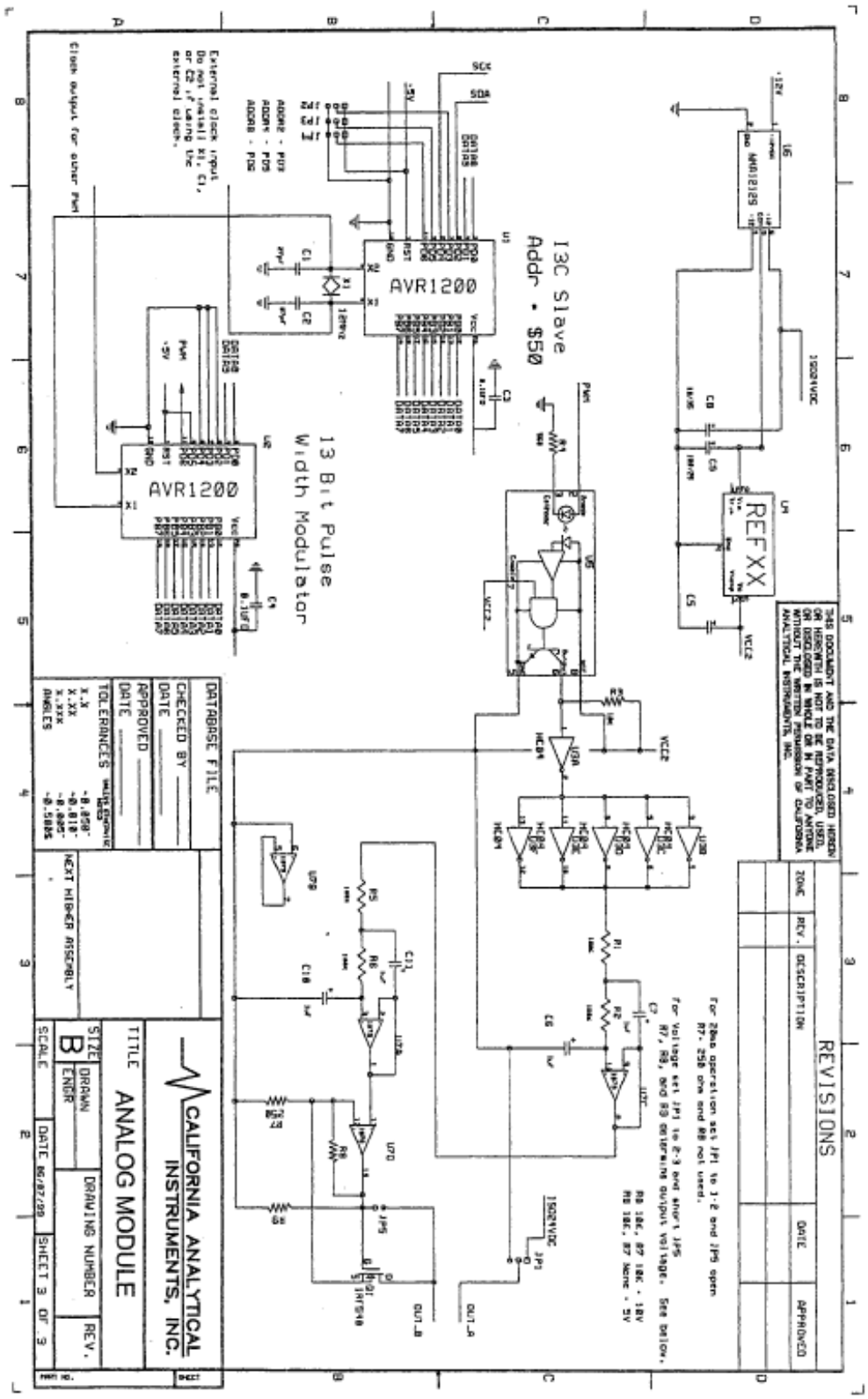
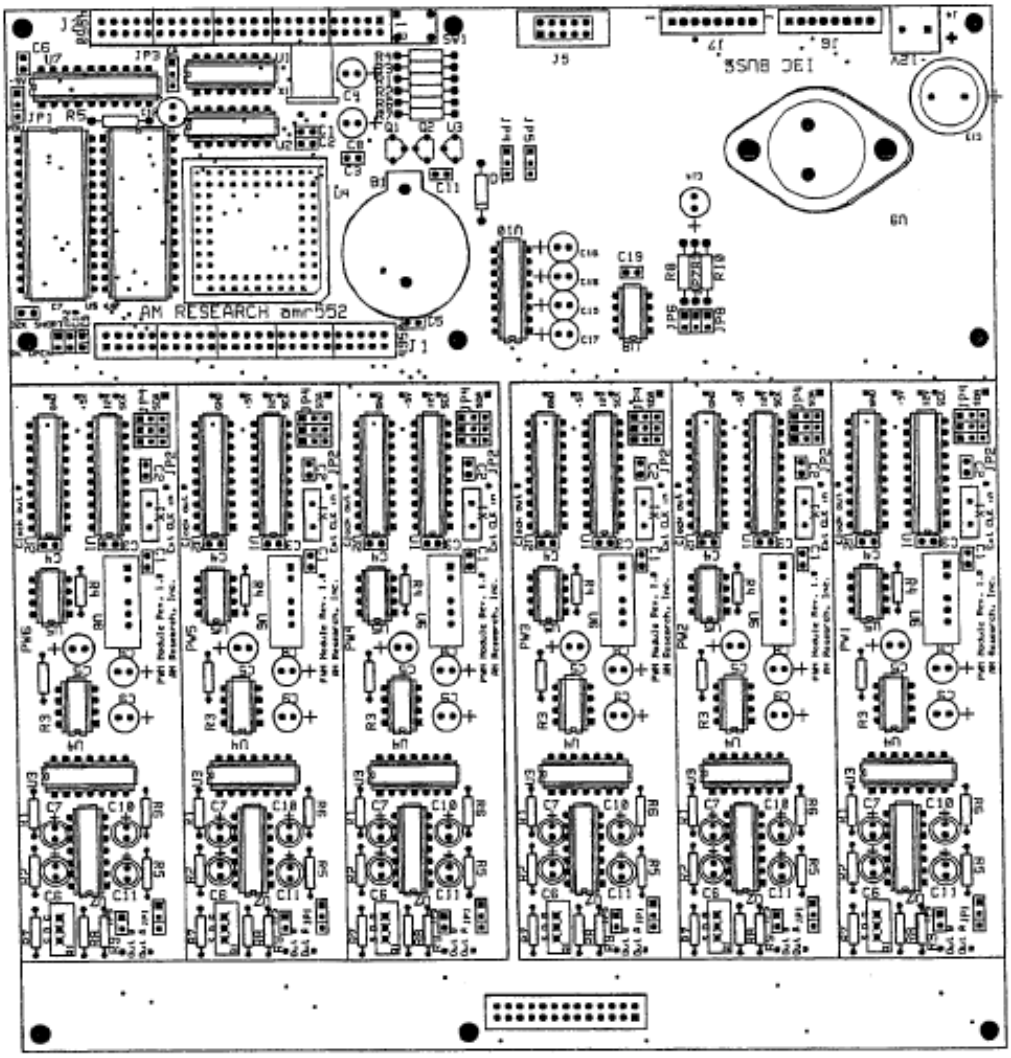

CALIFORNIA ANALYTICAL INSTRUMENTS, INC.
ANALOG MODULE
REVISIONS
DESCRIPTION
DATE
APPROVED
MAX 232
EEPROM


I3C Slave
Addr = $50
13 Bit Pulse
Width Modulator
AVR1200
AVR1200
REFXX
CALIFORNIA ANALYTICAL INSTRUMENTS, INC.
TITLE
ANALOG MODULE
REVISIONS
ZONE
REV.
DESCRIPTION
DATE
APPROVED
DATABASE FILE
CHECKED BY
DATE
APPROVED
DATE
TOLERANCES
NEXT HIGHER ASSEMBLY
SIZE
B
DRAWN
ENGR
SCALE
DATE 06/07/99
DRAWING NUMBER
REV.
SHEET 3 OF 3


AM RESEARCH amr552

4. Volgen America Switching Power Supply

Volgen America-SPN100 Series

100 WATT, Universal Input
Fully Enclosed Switching Power Supply

FEATURES

- POWER FACTOR CORRECTED
- UNIVERSAL INPUT (AC85-264V)
- BUILT-IN OVERVOLTAGE PROTECTION
- OVERCURRENT PROTECTION
- LIGHTWEIGHT CONSTRUCTION
- METAL CHASSIS WITH COVER
- COMPACT LOW-PROFILE PACKAGE
- 3 YEAR WARRANTY

SAFETIES/EMI

FCC-B
EN 55022-B
VCCI-II

ELECTRICAL SPECIFICATIONS

All specifications are typical at nominal input, full load.

INPUT SPECIFICATIONS

Input Voltage	AC 85V-264V DC 110V-340V
Input Frequency	47-63 Hz
Input Current	0.66~1.3A Typ
Inrush Current (100/230VAC cold start)	15~25A
Power Factor	0.99

OUTPUT SPECIFICATIONS

Output Voltage	See Chart
Output Adjustment	+/-10%
Efficiency	79~87%
Over-Voltage Protection	115 - 150% Manual Reset
Over-Current Protections	Automatic Recovery (105% min)
Ripple and Noise	100 mVp-p max.
Hold-Up Time	50 mS
Line/Load Regulation	See Chart
Rise Time	800-1600 mS
Leakage Current (100/230VAC)	0.75 mA

GENERAL SPECIFICATIONS

MTBF	>140,000 Hours
Isolation Voltage	
Primary to Secondary	3000 VAC
Primary to Case	1500 VAC
Secondary to Case	500 VAC
Isolation Resistance	100-Mohms min.

ENVIRONMENTAL SPECIFICATIONS

Operating Temperatures	0^{o}-60^{o}C Derates linearly 2.5%/^{o}C after 50^{o}C
Cooling	Convection
Temperature Coefficient	0.02%/^{o}C
Humidity	20 - 85% Rh (Non-condensing)
Storage Temperature	-20^{o}~85^{o}C
Shock Vibration	Shock: 20G (3 directions each 3 times) Vibration: 10~55Hz

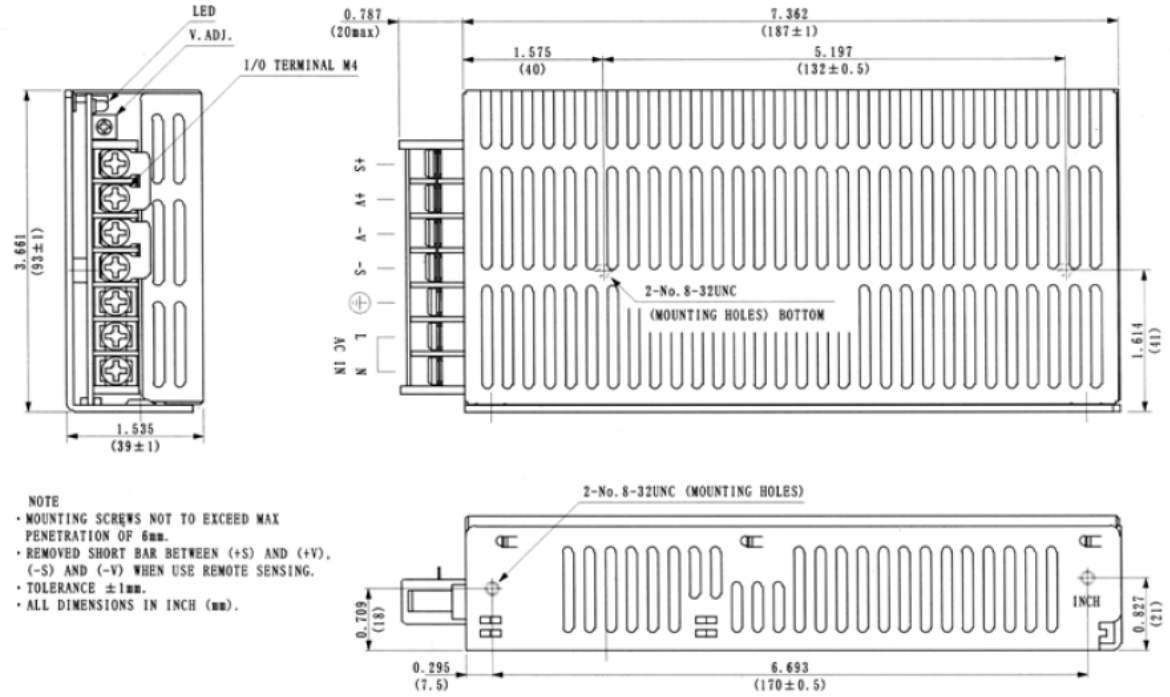
PHYSICAL SPECIFICATIONS

Metal Enclosed, Terminal Block

MODEL	OUTPUT VOLTAGE	CURRENT 85~264 VAC	OUTPUT CURRENT 100VAC	OUTPUT CURRENT 230VAC	LINE REGULATION (85~132VAC) (170~264VAC)	LOAD REGULATION (mVmax) (0-100% Load)
SPN100-05S	5V	20.0 A	79%	81%	10	20
SPN100-12S	12V	8.6 A	83%	85%	10	20
SPN100-15S	15V	7.0 A	83%	86%	10	20
SPN100-24S	24V	4.4 A	83%	86%	20	40
SPN100-48S	48 V	2.2 A	84%	87%	20	40

NOTE:

All specifications typical and nominal/full load and 25°C unless otherwise noted.
Avoid sustained operation in overload or dead short conditions.
Specifications subject to changes without notice.



***No. 6-32 mounting holes standard**
***Dimensions in mm**
***Terminal block or "pin" type connector available**

5. Thomas Diaphragm Pump, Model 107CAB18

DIAPHRAGM

Pumps and Compressors

107 Series

MODELS:

Standard models available.

107CAB18, 107CCD18, 107CEF18, 107CGH18
107CDC20

Other models based on availability and minimum purchase.

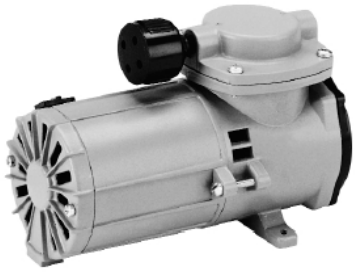
FEATURES (AC& DC):

- Oil-less operation
- Permanently lubricated bearings
- Closed housing and motor vents (107CDC/C only)
- Stainless valves
- Die cast aluminum head, valve plate and diaphragm hold down plate with dichromate conversion treatment
- Balanced for smooth, low vibration operation
- Long-life diaphragm
- Field service capability
- UL® recognized motor and thermal protector (115 Volt, AC only)
- Inlet filter
- CE approval on all standard 220-240/50hz models (Consult factory for non-standard models.)

Consult factory for custom applications

107CAB, CCD

107CEF, CGH



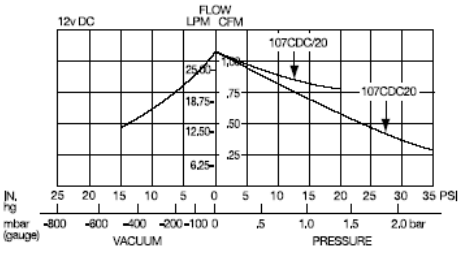
107CDC

ISO 9001 CERTIFIED

THOMAS® PUMPS & COMPRESSORS

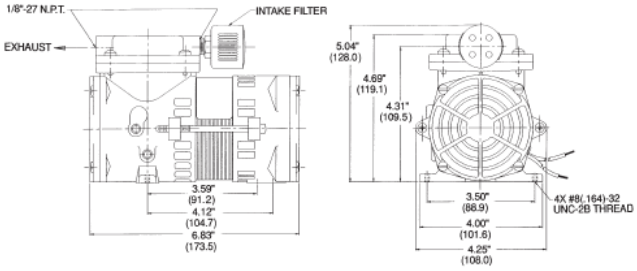
107 SERIES (DC) PERFORMANCE DATA:

		STANDARD			
MODEL NUMBER:		107CDC20		107CDC/C20	
HEAD CONFIGURATION:		Pressure/Vacuum		Pressure/Vacuum	
STROKE:		.200 Inches		.200 Inches	
PRESSURE:		Flow @ 12v		Flow @ 12v	
CFM @ PSI	LPM @ bar				
PSI	bar	CFM	LPM	CFM	LPM
0 5 10 15 20 25 30 35	0 .5 1.0 1.5 2.0 3.0	1.40 1.34 1.12 .94 .77 .61 .49 .39	39.6 35.1 27.1 20.2 14.5 6.2	1.40 1.34 1.12 .94 .77	39.6 35.1 27.1 20.1
MAX. CONTINUOUS PRESSURE:		35 PSI	2.4 bar	20 PSI	1.4 bar
MAX. INTERMITTENT PRESSURE:		35 PSI	2.4 bar	20 PSI	1.4 bar
VACUUM:		Flow @ 12v		Flow @ 12v	
CFM @ IN. hg	LPM @ mbar (gauge)				
IN. hg	mbar (gauge)	CFM	LPM	CFM	LPM
0 5 10 15 20 25	0 -100 -200 -400 -600	1.40 1.09 .80 .48	39.6 34.4 29.3 19.3 8.6	1.40 1.09 .80 .48	39.6 34.4 29.3 19.3 8.6
MAX. VACUUM:		22.9" hg	-775 mbar	22.9" hg	-775 mbar
MAX. AMBIENT TEMPERATURE:		104°F	40°C	104°F	40°C
MIN. AMBIENT TEMPERATURE:		50°F	10°C	50°F	10°C
MAX. RESTART PRESSURE:		15 PSI	1.0 bar	15 PSI	1.0 bar
MAX. RESTART VACUUM:		22.9" hg	-775 mbar	22.9" hg	-775 mbar
MOTOR VOLTAGE/FREQUENCY:		12v DC		12v DC	
HORSEPOWER:		1/10		1/10	
MOTOR TYPE:		Permanent Magnet		Permanent Magnet	
CURRENT AT RATED LOAD (AMPS):		8.5		8.5	
POWER AT RATED LOAD (WATTS):					
STARTING CURRENT (LOCKED ROTOR AMPS):		40.0		40.0	
INSULATION CLASS:		A		A	
MIN. FULL LOAD SPEED (RPM):		2970		2970	
THERMAL PROTECTOR:		No		No	
CAPACITOR VALUE:					
NET WEIGHT:		4.5 lbs.	2.0 Kg	4.7 lbs.	2.1 Kg

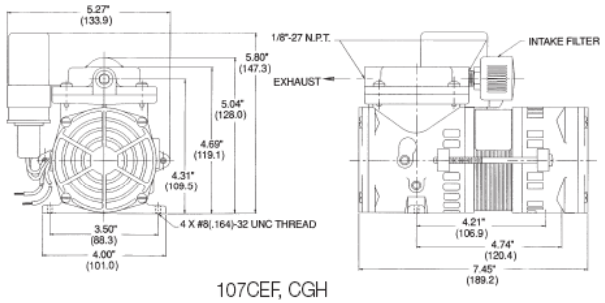


DIMENSIONS:

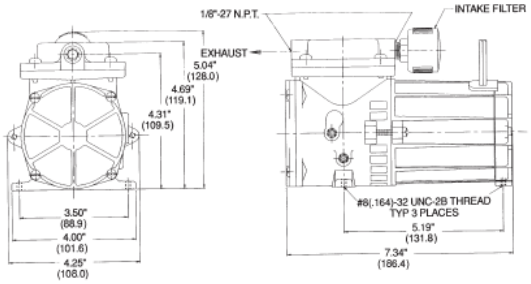
Millimeters are in ( )



107CAB, CCD



107CEF, CGH



107CDC & 107CDC/C

NOTE: 107CDC/C has closed motor vents

Note: Models pictured are representative of the series and do not represent a specific model number. Consult factory for detailed physical description.

Printed in U.S.A. Form No. 850-2274 9/01

THOMAS
PUMPS & COMPRESSORS
1419 Illinois Avenue, P.O. Box 29
Sheboygan, WI 53082-0029 USA
(920) 457-4891 Fax (920) 451-4276
Internet: http://www.thomaspumps.com

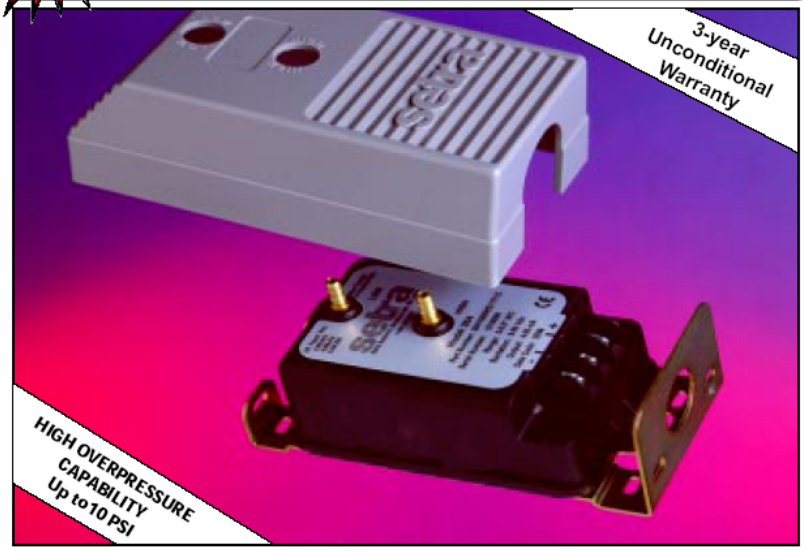
6. Setra Differential Pressure Transducer

GUARANTEED 3 DAY SHIPMENT FOR STANDARD PARTS (Less than 10 pieces)

Model 264

Very Low Differential Pressure Transducer

Unidirectional Ranges: 0 - 0.1 to 0 - 100 in. W.C.
Bidirectional Ranges: 0 - ±0.5 to 0 - ±50 in. W.C.
Air or Non-Conducting Gas



Setra Systems 264 pressure transducers sense differential or gauge (static) pressure and convert this pressure difference to a proportional electrical output for either unidirectional or bidirectional pressure ranges. The 264 Series is offered with a high level analog 0 to 5 VDC or 4 to 20 mA output.

Used in Building Energy Management Systems, these transducers are capable of measuring pressures and flows with the accuracy necessary for proper building pressurization and air flow control.

The 264 Series transducers are available for air pressure ranges as low as 0.1 in. W.C. full scale to 100 in. W.C. full scale. Static standard accuracy is ±1.0% full scale in normal ambient temperature environments, but higher accuracies are available. The units are temperature compensated to 0.033% FS/°F thermal error over the temperature range of 0°F to +150°F.

The Model 264 utilizes an improved all stainless steel micro-tig welded sensor. The tensioned stainless steel diaphragm and insulated stainless steel electrode, positioned close to the diaphragm, form a variable capacitor. Positive pressure moves the diaphragm toward the electrode, increasing the capacitance. A decrease in pressure moves the diaphragm away from the electrode, decreasing the capacitance. The change in capacitance is detected and converted to a linear DC electrical signal by Setra's unique electronic circuit.

The tensioned sensor allows up to 10 PSI overpressure (in either direction) with no damage to the unit. In addition, the parts that make up the sensor have thermally matched coefficients, which promote improved temperature performance and excellent long term stability.

NOTE: Setra quality standards are based on ANSI-Z540-1.
The calibration of this product is NIST traceable.

U.S. Patent nos. 4093915; 4358814; 4434203; 6019002; 6014800.
Other Patents Pending.

159 Swanson Rd., Boxborough, MA 01719/Telephone: 978-263-1400/Fax: 978-264-0292

Applications

- Heating, Ventilating and Air Conditioning (HVAC)
- Energy Management Systems
- Variable Air Volume and Fan Control (VAV)
- Environmental Pollution Control
- Lab and Fume Hood Control
- Oven Pressurization and Furnace Draft Controls

Features

- Up to 10 PSI Overpressure on All Ranges
- Installation Time Minimized with Snap Track Mounting and Easy- To-Access Pressure Ports and Electrical Connections
- 0 to 5 VDC or 2-wire 4 to 20 mA Analog Outputs Are Compatible with Energy Management Systems
- Reverse Wiring Protection
- Internal Regulation Permits Use with Unregulated DC Power Supplies
- Meets CE Conformance Standards

When it comes to a product to rely on - choose the Model 264. When it comes to a company to trust - choose Setra.

ISO 9001 Certified

Visit Setra Online:
http://www.setra.com

setra

800-257-3872

Model 264 Specifications

Performance Data

	Standard	Optional	
Accuracy* RSS(at constant temp)	±1.0% FS	±0.4% FS	±0.25% FS
Non-Linearity, BFSL	±0.96% FS	±0.38% FS	±0.22% FS
Hysteresis	0.10% FS	0.10% FS	0.10% FS
Non-Repeatability	0.05% FS	0.05% FS	0.05%FS

Thermal Effects**

Compensated Range °F (°C)	0 to +150 (-18 to +65)
Zero/Span Shift %FS/°F(°C)	0.033 (0.06)
Maximum Line Pressure	10 psi
Overpressure	Up to 10 psi in Positive or Negative Direction.
Long Term Stability	0.5% FS/1 YR

Position Effect (Unit is factory calibrated at 0g effect in the vertical position.)	Range	Zero Offset (%FS/G)
	To 0.5 in. WC	0.60
	To 1.0 in.WC	0.50
	To 2.5 in.WC	0.22
	To 5 in. WC	0.14

* RSS of Non-Linearity, Hysteresis, and Non-Repeatability.
**Units calibrated at nominal 70 °F. Maximum thermal error computed from this datum.

Environmental Data

Temperature	
Operating* °F (°C)	0 to +175 (-18 to +79)
Storage °F (°C)	-65 to +250 (-54 to +121)

*Operating temperature limits of the electronics only. Pressure media temperatures may be considerably higher.

Physical Description

Case	Fire-Retardant Glass Filled Polyester
Mounting	Four screw holes on removable zinc plated steel base (designed for 2.75" snap track)
Electrical Connection	Screw Terminal Strip
Pressure Fittings	3/16" O.D. barbed brass pressure fitting for 1/4" push-on tubing
Zero and Span Adjustments	Accessible on top of case
Weight (approx.)	10 ounces

Pressure Media

Typically air or similar non-conducting gases.

Specifications subject to change without notice.

Electrical Data (Voltage)

Circuit	3-Wire (Com, Exc, Out)
Excitation	9 to 30 VDC
Output*	0 to 5 VDC**
Bidirectional output at zero pressure:	2.5 VDC**
Output Impedance	100 ohms

*Calibrated into a 50K ohm load, operable into a 5000 ohm load or greater.
**Zero output factory set to within ±50mV (±25 mV for optional accuracies).
**Span (Full Scale) output factory set to within ±50mV. (±25 mV for optional accuracies).

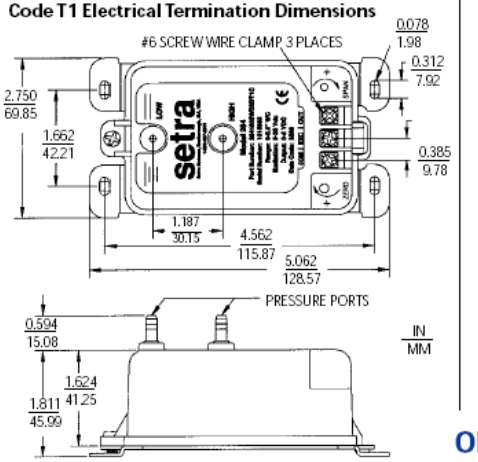
Electrical Data (Current)

Circuit	2-Wire
Output*	4 to 20mA**
Bidirectional output at zero pressure:	12mA**
External Load	0 to 800 ohms
Minimum supply voltage (VDC) = 9+ 0.02 x (Resistance of receiver plus line).	
Maximum supply voltage (VDC) = 30+ 0.004 x (Resistance of receiver plus line).	

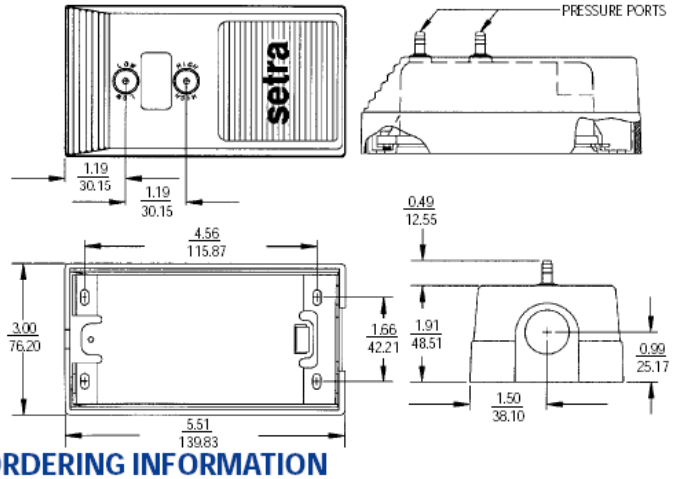
*Calibrated at factory with a 24 VDC loop supply voltage and a 250 ohm load.
**Zero output factory set to within ±0.16mA (±0.08 mA for optional accuracies).
**Span (Full Scale) output factory set to within ±0.16mA (±0.08 mA for optional accuracies).

Outline Drawings

Code T1 Electrical Termination Dimensions



Optional 1/2" Conduit Electrical Enclosure Dimensions



SSP264 Rev.D 04/19/01

ORDERING INFORMATION

Code all blocks in table.

Example: Part No. 26412R5WD11T1C for a 264 Transducer 0 to 2.5 in. WC Range, 4 to 20 mA Output, Terminal Strip Electrical Connection, and ±1% Accuracy.

2 6 4 1 — [ ][ ][ ][ ][ ] — [ ][ ] — [ ][ ] — [ ]

Model
2641 = 264

Ranges

Differential		Bidirectional	
0R1WD	= 0 to 0.1 in. WC	**R05WB**	= ±0.05 in. WC
R25WD	= 0 to 0.25 in. WC	**0R1WB**	= ±0.1 in. WC
0R5WD	= 0 to 0.5 in. WC	**R25WB**	= ±0.25 in. WC
001WD	= 0 to 1 in. WC	**0R5WB**	= ±0.5 in. WC
2R5WD	= 0 to 2.5 in. WC	**001WB**	= ±1 in. WC
003WD	= 0 to 3 in. WC	**1R5WB**	= ±1.5 in. WC
005WD	= 0 to 5 in. WC	**2R5WB**	= ±2.5 in. WC
010WD	= 0 to 10 in. WC	**005WB**	= ±5 in. WC
015WD	= 0 to 15 in. WC	**7R5WB**	= ±7.5 in. WC
025WD	= 0 to 25 in. WC	**010WB**	= ±10 in. WC
050WD	= 0 to 50 in. WC	**025WB**	= ±25 in. WC
100WD	= 0 to 100 in. WC	**050WB**	= ±50 in. WC

Output
11 = 4-20 mA
2D = 0 to 5 VDC

Elec. Termination
Standard
T1 = Terminal Strip
Optional
A1 = 1/2" Conduit Enclosure

Accuracy
Standard
C = ±1% FS
Optional (w/Cal. Cert.)
E = ±0.4% FS
F = ±0.25% FS
G = ±1% FS

Please contact factory for versions not shown.

While we provide application assistance on all Setra products, both personally and through our literature, it is the customer's responsibility to determine the suitability of the product in the application.

159 Swanson Road, Boxborough, MA 01719/Tel: 978-263-1400;
Toll Free: 800-257-3872; Fax: 978-264-0292; email: sales@setra.com

7. Vaisala Humidity and Temperature Sensor

VAISALA

P.O. Box 26, FIN-00421 Helsinki, FINLAND
Tel: +358 9 894 91
Fax: +358 9 8949 2485
Email: industrialsales@vaisala.com
www.vaisala.com

HMW61/71 Humidity and Temperature Transmitter for Industrial/HVAC Applications

Vaisala HUMICAP® Humidity and Temperature Transmitters HMW61/71 are protected against dust and sprayed water.

Features/Benefits

- Full 0...100 %RH measurement
- Accuracy up to ±2 %RH
- True two-wire transmitter with a 4...20 mA loop powered output (HMW61)
- Three-wire transmitter with a selectable signal output of 0...1 V, 0...5 V or 0...10 V (HMW71)
- Optional temperature measurement
- Electronic, on-site, one-point calibration
- Vaisala HUMICAP® Sensor for excellent accuracy and long-term stability, negligible hysteresis and resistance to dust and most chemicals.
- Temperature compensated
- IP65 (NEMA 4) housing
- NIST traceable (certificate included)

The wall mount Vaisala HUMICAP® Humidity and Temperature Transmitters HMW61 and HMW71 are designed for monitoring relative humidity and temperature in demanding environments.

Withstands dust and sprayed water

The transmitters are protected against dust and sprayed water, meeting the IP65 (NEMA 4) requirements. All the materials used have been chosen for excellent corrosion resistance. In addition, the transmitters incorporate Vaisala HUMICAP® Sensor, which is insensitive to dust and most chemicals.

All of these features make the HMW61/71 transmitters especially suitable for humid and wet environments, e.g. greenhouses, live stock farms, indoor swimming pools and other wash down areas.

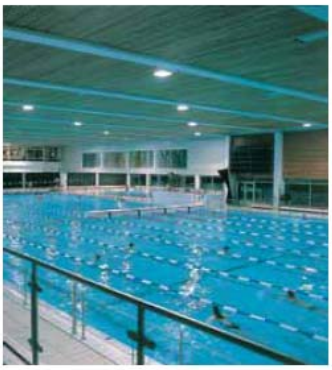
Measures both humidity and temperature

The HMW61/71 transmitters are available as relative humidity only (U), and as relative humidity and temperature (Y).

Fast, on-site calibration

The accuracy of the transmitters is simple to check using either the Vaisala HUMICAP® Hand-Held Humidity and Temperature Meter HM70 or the Vaisala HUMICAP® Humidity Indicator HMI41. The calibration can be done in seconds with a single potentiometer without disturbing operation, resulting in savings in both maintenance time and costs.

Customized calibration and maintenance contracts for HMW61/71 are available on request.



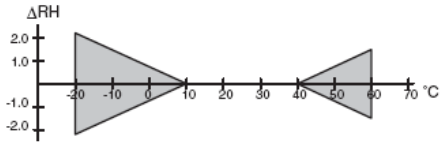
Vaisala HUMICAP® Humidity and Temperature Transmitters HMW61/71 are especially suitable for humid and wet environments.

Technical Data

Relative humidity

Measurement range	0 to 100 %RH
Accuracy at +20 °C (+68 °F)	±2 %RH (0 to 90 %RH)
	±3 %RH (90 to 100 %RH)

Temperature dependence

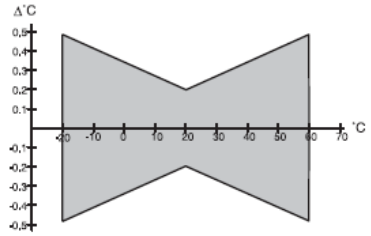


Response time (90%) at	
+20 °C (+68 °F) in still air	15 seconds (with membrane filter)
Humidity sensor	HUMICAP® 180

Temperature (Y model only)

Measurement range	-20...+60 °C (-4...+140 °F)
	Optional temperature scales available on request.

Accuracy



Linearity	better than 0.1 °C (0.18 °F)
Temperature sensor	Pt 1000 IEC 751 class B

General HMW61U/Y

Supply voltage	10...35 VDC (RL = 0 ohms)
	20...35 VDC (RL = 500 ohms)
Output signal	4...20mA

Output signal corresponds to 0...100 %RH and -20...+80 °C (-4...+176 °F)

General HMW71U/Y

Supply voltage range depends on the selected output signal. When an AC supply is used, an isolated source is recommended.

	DC	AC
0...1 V	10...35 V	9...24 V
0...5 V	14...35 V	12...24 V
0...10 V	19...35 V	16...24 V

Output signal corresponds to 0...100 %RH and -20...+80 °C (-4...+176 °F)

Factory setting 0...1 V. Other outputs selectable by jumper connections. An output change causes an error, which is less than 0.5 %RH without recalibration.

Power consumption @ 24 VAC	
HMW71U	10 mA typical
HMW71Y	12 mA typical

General

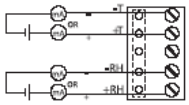
Operating temperature range	-20 °C...+60 °C (-4...+140 °F)
Storage temperature range	-40 °C...+80 °C (-40...+176 °F)
Material:	
Housing	ABS/PC plastic
Probe	ABS/PC plastic
Mounting plate	ABS plastic
Housing classification	IP65 (NEMA 4)
Sensor protection	
Membrane filter	part no. DRW010525
Probe cap	part no. HM47329
Connections	Screw terminals
	0.5...1.5 mm²

For field check
HM70 hand-held humidity and temperature meter or
HMI41 humidity indicator

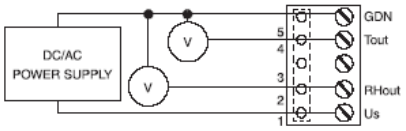
Complies with EMC standard EN61326-1:1997 + Am1:1998 + Am2:2001; Industrial Environment.

Wiring

HMW61 wiring diagram

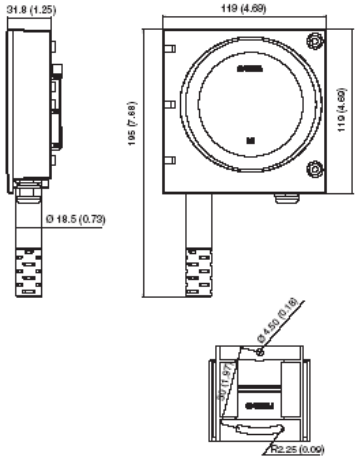


HMW71 wiring diagram



Dimensions

Dimension in mm (inches).



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Specifications subject to change without prior notice.
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CE

8. Fluorotherm FEP Tubing

FLUOROTHERM™

Tubing and Coils | Fabricated Products | Immersion Heat Exchangers | Shell & Tube Heat Exchangers | Fluoropolymer Rods

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FLUOROPOLYMER PRODUCTS FROM PTFE, FEP, PFA, MFA, CTFE, ETFE, PVDF AND ECTFE

TYPICAL PROPERTIES OF FLUOROPOLYMERS

Property	Method No.	Units	PTFE	FEP	PFA	ETFE	ECTFE	PCTFE	PVDF
Specific Gravity	D792	-	2.17	2.15	2.15	1.74	1.7	1.7	1.78
Melting Point	D2236	deg F	621	518	581	527	464	410	352
Tensile Strength	D638	psi	2,900	4,350	4,570	6,960	6,960	6,060	7,830
Yield Strength	D638	psi	1,450	1,740	2,250	3,480	4,500	5,800	6,670
Elongation		%	200-500	250-350	300	200-500	200-300	80-250	20-150
Tensile Modulus	D638	ksi	87	72.5	101.5	217.5	240	218	348
Flex Modulus	D790	ksi	98	101.5	95	203	261	-	333.5
Izod Impact	D256	ft-lbs/in	3.2	-	-	-	-	-	2-4
Hardness	D2240	Shore D	60	57	62	75	75	90	79
HDT, @ 66 psi	D648	deg F	250	158	164	219	240	248	300
HDT, @ 264 psi	D648	deg F	122	129	118	160	169	-	239

All mechanical strength properties given at room temperature only. These properties decrease significantly with rise in temperature, at a different rate for different materials.

Teflon® - DuPont Company Trademarks for PTFE, FEP, PFA resins
Neofon® - Daikin, Inc. Trademark for PTFE, FEP, PFA resins
Hyflon® - Ausimont Trademark for MFA resin
Tefzel® - DuPont Company Trademark for ETFE resin
Halar® - Ausimont/Allied Chemicals Trademark for ECTFE resin
Kynar® - Atochem Trademark and Hylar® - Ausimont Trademark for PVDF resin

PTFE VERSUS FEP - PROPERTY COMPARISON

1. Chemical Structure: PTFE - homopolymer, FEP - copolymer
2. Continuous Use Temperature: PTFE - 500 deg F, FEP - 399 deg F
3. Melt Temperature: PTFE - Does not melt, softens at 625 deg F, FEP - 500 deg F
4. PTFE, being a homopolymer, has the best thermal and best chemical resistance compared to copolymers.
5. Tensile Strength at 23 deg C: PTFE - 2500 psi - 3553 psi* (see reference below) FEP 100 - 3335

http://www.fluorotherm.com/properties.htm (1 of 2)6/6/2005 8:48:25 AM

Fluorotherm - Properties

psi*
In general PTFE has a tensile strength 15% to 20% lower than FEP; however, this difference may narrow at higher operating temperatures due to the higher sensitivity of FEP to increase to temperature.

6. See Fluorotherm brochure PB-7-93, for additional information on PTFE.

Ref: Encyclopedia, Polymer Science "Eng., Vol. 16, IInd Ed., 577, 1989, J. Wiley Sons".

The information, recommendations and opinions contained herein are presented solely for your consideration, inquiry and verification, and are not, in part or total, to be construed as constituting a warranty or representation for which we assume legal responsibility. Nothing contained herein is to be interpreted as a license or authorization to operate under or infringe any patent

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Electronic mail: sales@fluorotherm.com
Customer Support: sales@fluorotherm.com

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9. API UV Fluorescence Non-Methane Hydrocarbon Analyzer

Table 2-1: Model 101E Basic Unit Specifications

Min/Max Range (Physical Analog Output)	In 1 ppb increments from 50 ppb to 20 000 ppb, independent ranges or auto ranging
Measurement Units	ppb, ppm, µg/m3, mg/m3 (user selectable)
Zero Noise[1]	0.2 ppb RMS
Span Noise[1]	0.2 ppb RMS
Lower Detectable Limit[2]	0.4 ppb RMS
Zero Drift (24 hours)	<0.5 ppb
Zero Drift (7 days)	1 ppb
Span Drift (7 Days)	<0.5% FS
Linearity	1% of full scale
Precision	0.5% of reading[1]
Temperature Coefficient	< 0.1% per °C
Voltage Coefficient	< 0.05% per V
Rise/Fall Time[1]	95% in <100 sec
Sample Flow Rate	650cc/min. ±10%
Temperature Range	5-40oC
Humidity Range	0 - 95% RH, non-condensing
Dimensions H x W x D	7" x 17" x 23.5" (178 mm x 432 mm x 597 mm)
Weight, Analyzer (Basic Configuration)	45 lbs (20.5 kg) w/internal pump
AC Power Rating	100 V, 50/60 Hz (1.7 A / 2.3 A surge); 115 V, 60 Hz (1.5 A / 2.0 A surge); 220 – 240 V, 50/60 Hz (.0.75 A \ 1.0 A surge)
Environmental	Installation category (over-voltage category) II; Pollution degree 2
Analog Outputs	Three (3) Outputs
Analog Output Ranges	100 mV, 1 V, 5 V, 10 V, 2-20 or 4-20 mA isolated current loop. All Ranges with 5% Under/Over Range
Analog Output Resolution	1 part in 4096 of selected full-scale voltage
Status Outputs	8 Status outputs from opto-isolators
Control Inputs	6 Control Inputs, 3 defined, 3 spare
Serial I/O	One (1) RS-232; One (1) RS-485 (2 connecters in parallel) Baud Rate : 300 – 115200: Optional Ethernet Interface
Certifications	EN61326 (1997 w/A1: 98) Class A, FCC Part 15 Subpart B Section 15.107 Class A, ICES-003 Class A (ANSI C63.4 1992) & AS/NZS 3548 (w/A1 & A2; 97) Class A IEC 61010-1:90 + A1:92 + A2:95,
For indoor use at altitudes ≤ 2000m only	
[1] As defined by the USEPA. [2] Defined as twice the zero noise level by the USEPA.	

10. Tapered Element Oscillating Microbalance (TEOM)

Series 1400a

TEOM® Automated Ambient Particulate Monitor

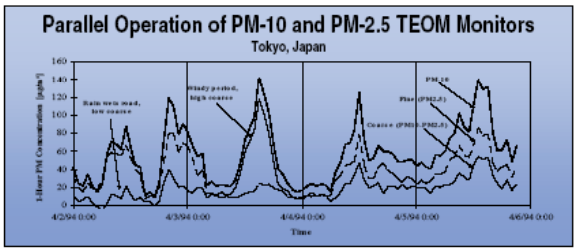
Complete Outdoor Enclosure

Features

- Continuous *True Mass* Measurement with Unmatched Short-Term (Hourly) Precision and Resolution
- PM-10, PM-2.5, PM-1, TSP Inlets
- Active Volumetric Flow Control Using Advanced Mass Flow Controllers
- No Radioactive Components
- Audit and Calibration Using NIST-Traceable Mass and Flow Standards
- USEPA PM-10 (EQPM-1090-079) and PM-2.5, Worldwide Approvals

Streamline Pro™ MultiCal™ Unit for Flow Audit/Calibration

Mass Calibration Verification Kit



Series 8500 FDMS® System

- Measures *Total Atmospheric Aerosol* Mass Concentration
- Accounts for Non-volatile and Volatile PM Components with Innovative Self-Referencing Methodology

Series 8100 Aethalometer™ Module

- Continuous Black Carbon (BC) Analyzer for the TEOM Monitor

www.rpco.com

Rupprecht & Patashnick Co., Inc.

Feb 05

FEATURES SHEET

TEOM® SERIES 1400A AMBIENT PARTICULATE MONITOR

The Series 1400a monitor has the following features:

- Incorporates Thermo's "AB" technology for enhanced measurement stability–ideal for mobile installations. Alternate configurations for specialized applications: Sample Equilibration System (SES) and Series 8500 Filter Dynamics Measurement System (FDMS™ Unit).
- Filter-based direct mass monitoring using Thermo's patented TEOM® technology that *never* requires mass recalibration. The instrumentation contains *no* radioactive components. Industry-leading 2 year warranty.
- The only continuous dust monitor with USEPA approval (EQPM-1090-079) that complies with the California ARB 1-hour acceptance criteria for mass concentration precision. TEOM instrumentation has German EPA approval for TSP and PM-10 measurements.
- Unsurpassed mass and time resolution (mass transducer minimum detection limit of 0.01 µg). Precision of ±5.0 µg/m³ for 10-minute averaged data and ±1.5 µg/m³ for 1-hour averages.
- ActiVol™ flow control system maintains a constant volumetric flow at the flow rate specified by the user by incorporating ambient pressure and temperature sensors.
- NIST-traceable audit/calibration of mass determination and flow rate.
- Available with a choice of sample inlets for PM-10, PM-2.5, PM-1 or TSP measurements.
- Sample filters can be analyzed after exposure for heavy metals with laboratory techniques such as AA or ICAP.
- Flexible viewing and entry of instrument parameters made possible by a menu-driven user interface. Keypads are available in English, Spanish and German.
- Internal data logging of up to 40 weeks with one variable stored every hour. Each record may contain up to eight user-selectable variables.
- Three real-time analog outputs (0-1, 0-2, 0-5 or 0-10 VDC), and two user-defined contact closures alarm circiuts.
- Two levels of password protection–low and high lock. These can be used to restrict access to instrument functions.
- Advanced RS-232 support. This allows users to retrieve real-time and stored information and change instrument parameters, both remotely and at the sampling location.
- Seven built-in averaged analog inputs (scalable as ±2 or ±10 VDC) with user-defined conversions to engineering units. The averaging time is equal to the user-defined data storage interval. Averaged values may be logged internally.
- Analog inputs from a wind vane/anemometer are used to compute averaged wind speed, and vector-averaged velocity and direction.
- Built-in support for the optional ACCU™ system. The ACCU system is an intelligent sampler that offers the user great flexibility in the sampling of particulate and/or gases through filter cartridges or gas collection tubes.

Thermo ELECTRON CORPORATION
Air Quality Instruments
rp Products
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East Greenbush, NY 12061
(518)452-0065
(518)452-0067 fax
ISO9001:2000 Certified

11. VIG Industries Hydrocarbon Analyzer

Heated Methane / NonMethane / Total Hydrocarbon Analyzer (NMHC)
Model-200

VIG INDUSTRIES, INC

The VIG Industries, Inc. Model-200 is a microprocessor based, oven heated methane / nonmethane / total hydrocarbon gas analyzer designed for high accuracy, sensitivity and stability. The Model-200 uses two independent flame ionization detectors (FIDs), one to measure total hydrocarbons and the second coupled with a GC Column for the separation of the methane and nonmethane components. A sample is fed to the analyzer via an internal heated pump to the first FID for a real time total hydrocarbon reading. A portion of the sample is trapped and pushed through a column to separate the methane component and then to the second FID. Any remaining sample in the column is back flushed through the column to obtain the nonmethane component. All components that come in contact with the sample through analysis are maintained in a temperature-controlled oven to prevent condensation, and to provide repeatable, reliable performance in the analysis of a wide variety of hydrocarbon concentrations in gaseous mixtures or in ambient air.

Features
- Easy to use software
- Automatic start-up/ignition
- Heated sample pump heads
- Two stage sample filter with exchangeable sintered stainless steel elements
- Teflon isolated detectors (FIDs)
- Automatic fuel shut-off system
- Automatic flame-out indicators
- Adjustable alarm and oven settings
- Precision 1% of full scale
- 19" rack/bench mount

Options
- 4-20mA output - no extra charge
- Zero and calibration solenoids with software
- RS-232 interface
- Internal combustion air supply

Related Available Equipment
- Zero air generator (Reduces bottles)
- Hydrogen generator (Reduces bottles)
- Heated sample lines and controllers
- Strip chart recorders and data loggers
- NEMA rated enclosures

Applications
- *Compliance Monitoring* - U.S. E.P.A. Method 18 and Method 25A
- *Process Monitoring* - Continuous monitoring and alarm or control of: process gas streams utilizing organic solvents, crude oil, and other chemicals containing hydrocarbons.
- *Efficiency Monitoring* - Monitoring effluent of volatile organic compound (VOC) reduction equipment for environmental compliance, efficiency control of incinerators (Thermal or catalytic), scrubbers, carbon absorbers, and other abatement equipment, monitoring of catalytic converters, combustion and diesel engine efficiency.
- *Safety Monitoring* - Lower explosive limit (LEL) monitoring and/or control of ovens/dryers, fugitive emissions monitoring, personnel work area monitoring, leak detection of process equipment or solvent storage areas.
- *Stack Monitoring*

VIG INDUSTRIES, INC.
4051 E. La Palma #C Anaheim, CA 92807 • Toll Free (800)862-7844 • Phone (714)632-8200 • Fax (714)632-8201 • http://www.vigindustries.com

Standard Specifications

Measuring Method - 2 Oven Heated, Flame Ionization Detectors (FIDs)
Separation Method - GC Column
Measurement Range/Standard Ranges - (4 Ranges per amplifier, 2 amplifiers per analyzer, 1 amplifier for total and 1 amplifier for methane and nonmethane)
- 0-10, 0-100, 0-1000, 0-10000ppm (Lower detection limit 0.01ppm) or
- 0-100, 0-1000, 0-10000, 0-100000ppm (Lower detection limit 0.1ppm)
- Other ranges available upon request

Zero & Span Noise - Less than 0.2% of full scale
Zero & Span Drift - +/- 1% full scale per 24 hours
Linearity- Within 1% of full scale through all ranges
Repeatability - Within 1% of full scale through all ranges
Stability - Within 1% of full scale through all ranges
Oxygen Synergism - Within 1% of full scale within selected range
Response Time
- Total - Within 5 seconds to 90% of final reading (Continuous real time reading)
- Methane - Approximately 40 seconds, updated every 3 minutes
- Nonmethane - Approximately 70 seconds, updated every 3 minutes

Ambient Temperature - From 50°F to 120°F
Flow Rate - 4 Liters/Minute (Standard) or 10 Liters/Minute (Upon request)
Physical Dimensions - 19" Wide Front Panel, 16.75" Wide Chassis, 24" Deep Chassis, 27" Deep with fittings and handles, 9" High
Weight - 55 lbs to 65 lbs depending on options
Oven operating temperature - 275°F (Adjustable from 200°F to 300°F)
Safety - Flame-Out indicator lamp, flame-out alarm contacts on back panel, fuel shut-off, calibration and zero solenoid shut-off
Voltage Outputs - One of the following voltage outputs
- 0-10VDC (Standard), 0-1VDC or 0-5VDC (Optional – no extra charge)

Current Outputs - 4-20mA, Sourcing (Optional – no extra charge)
Flame-Out Alarms - Normally open, low current relay contacts (Close on alarm, latching)
Concentration Alarms - Normally open, low current relay contacts (Close on alarm, latching)
Ignition - Automatic (Can be set to manual by operator from front panel)
Glow Plugs - Main and spare glow plugs installed (Selectable by switch on back panel)
Warm-up Time
- Usable in approximately 45 minutes
- Stable in approximately 2 hours

Display - Graphic, backlit, 240W x 64H pixels, high contrast, wide viewing angle

Operation Requirements

Fuel - UHP Hydrogen @ 18psi incoming pressure
Combustion Air - Oil/Water/Hydrocarbon free instrument air @ 18psi incoming pressure
Zero Calibration Gas - UHP zero grade air or nitrogen @ 9psi incoming pressure
Span Calibration Gas - Known concentration of operator selected hydrocarbons balanced in either air or nitrogen @ 9psi incoming pressure (VIG recommends using a mixture of methane and propane balanced in air to save calibration time)
Carrier Gas - UHP nitrogen @ 30psi incoming pressure
Compressed Air - Oil/Water free air @ 50psi incoming pressure for column switching valve
Power Requirements - 115VAC @ 60Hz @ 720Watts or optional 220VAC @ 50Hz

Warranty

All instruments sold by VIG Industries, Inc. are warranted for a period of one (1) year from date of purchase against defects in materials and workmanship. The seller warrants that the product supplied conforms to the specifications assigned thereto. There is no other warranty either expressed or implied. Seller liability is limited specifically to the cost or assigned value of the items sold. Service contracts are available after the warranty expires.

12. Rotem RSC-2 Poultry Scale System

ROTEM

Take Control!

COMPUTERIZED CONTROLLERS

RSC-2

Automatic Live Bird Scale

For Broilers, Breeders, Pullets and Turkeys. Special program that weighs males and females separately, providing separate data on the same platform.

The RSC-2 is a stand-alone live bird scale center. It assures continuous accurate daily data collection of average bird weight, number of weighings, daily weight gain, standard deviation, CV and uniformity.

The RSC-2 can handle up to two bird scale platform placed on the litter in the same or different houses. It is very simple to use. Rotem's unique user-friendly Scale Center uses easy to understand menu.

The sophisticated software can accurately weigh the birds even if more than one bird is stepping on the platform at the same time.

You can link an unlimited number of Rotem bird scale centers to a nationwide communication network, controlled by one central PC via modem, using Rotem's advanced communication program for Windows.

The platforms are made of a high quality stainless steel and are completely sealed to prevent any damage to the excellent load cells installed inside. Rotem uses high quality cables to ensure long life in the harsh litter environment.

Features:

- Up to two bird scales.
- Five digit display.
- Up to 500 days data collection.
- User friendly 3 key programming.
- Weight displayed in Kg. or Lb.
- 115 / 230 VAC operation.
- Local or remote modem PC communication.
- Unerasable memory.
- Power surge protection.
- Water and dust resistant enclosure.
- Simple installation.

ISO 9001:2000 IQC

CE

ROTEM
Computerized Controllers

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Petach Tikva 49511
ISRAEL
Tel: +972-3-9206200
Fax: +972-3-9249834

www.rotem.com E-mail: rotem@rotem.com

13. Barometric Pressure Sensor

WATER

WE100 Barometric Pressure Sensor

- 4-20 mA output
- Marine grade cable with strain relief

Description

Global Water's highly accurate Barometric Pressure Sensor covers a pressure range from 800 to 1100 mb. The barometric pressure indicator is fully temperature compensated within an operating range of -40° to 65° C. The sensor is mounted on 25' of marine grade cable, with lengths up to 500' available upon request. The sensor output is 4-20 mA with a two wire configuration.

Specifications

Output: 4-20 mA
Range: 800-1100 mb
Accuracy: ±1% of full scale
Linearity/Hysteresis: ± 0.1%
Operating Voltage: 10-36 VDC
Current Draw: Same as sensor output
Warm Up Time: 3 seconds minimum
Operating Temp: -40° to +55°C
Sensor Size: 3"x2"x1"
Weight: 0.13 lb.

Contact Global Water for all your instrumentation needs:

Water Level
Water Flow
Water Samplers
Water Quality
Weather
Remote Monitoring
Control

Price List

WE100
Barometric Pressure Sensor.....$375

WQEXC Extra Cable
Cable length is measured from end of cable to bottom of sensor.
After 25', up to 500'.....$1.10/ft

Global Water
The Leader in Water Instrumentation

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